ENERGY INFORMATION PAPER

INDUSTRY ENERGY TRENDS

ENERGY TRENDS IN ONTARIO
A FIVE PART SERIES

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INTRODUCTION

This paper is one of a five-part series that analyzes the recent historical trends in Ontario's energy consumption, and complements the forecast of provincial energy demand contained in **Energy 2000: The Shape of Ontario's Energy Demand.**

This paper details the trends that have emerged in industrial energy use in Ontario. The other papers in the series highlight trends in residential, transportation, commercial and institutional buildings, and total energy use for the province.

INDUSTRY ENERGY TRENDS

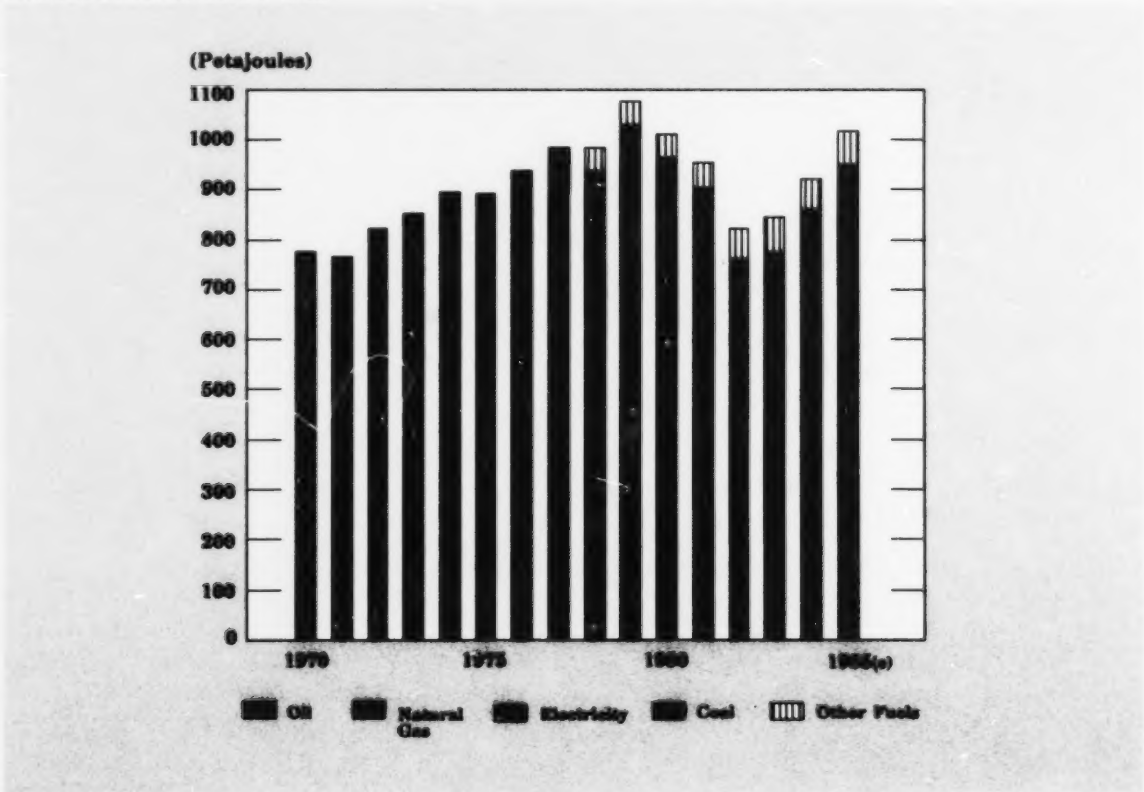
Ontario is the industrial heartland of Canada. Industrial output provides about 40 per cent of Ontario's gross domestic product. Three out of every 10 jobs depend directly on industrial activities.

Ontario's industrial output serves both Canadian and international markets. But the United States is Ontario's largest trading partner. More than 80 million people live within a radius of 800 kilometres from Toronto, most of them in the U.S. This population base is among the most affluent in the world, and provides a ready market for Ontario-produced goods. In fact, in 1984, more than three-quarters of Ontario's total industrial output — worth some $50 billion — was exported, primarily to the United States. Ontario's industrial sector is the largest consumer of energy in the province, and accounts for about 40 per cent of the province's total energy use.

For the purpose of this paper, Ontario's industrial sector includes manufacturing, mining, agriculture, forestry and construction. These activities use all types of energy, sometimes in very unique ways.

For example, farmers use gasoline and diesel fuel to power their combines and tractors, but they also use a large amount of natural gas and propane to dry grain and

INDUSTRIAL ENERGY USE



Source: Statistics Canada

cure tobacco. Vast amounts of electricity are required in certain chemical processes, such as the electrolytic production of chlorine and sodium. Paper manufacturers burn wood waste, spent pulping liquor and conventional fuels to cook wood pulp. Iron and steel producers require large quantities of coal, not only for the heat to smelt iron ore, but also as a carbon source to give steel desirable properties, such as strength and hardness. The petrochemical industry consumes fuels for their energy content and their chemical structure, using oil and natural gas to produce the raw materials required to make plastics and other petrochemicals.

When the amount of industrial energy consumed in Ontario is added up by end-use, fully two-thirds is used to generate heat for production processes. The remaining third is divided among lighting, electrolytic processes, space heating, motive power and feedstock uses.

Between 1970 and 1985, Ontario's total industrial energy consumption grew by over 38 per cent, or just over two per cent per year. Excluding all the energy that's used for petrochemical production and other non-energy uses, however, energy demand grew by only 15 per cent. But this growth was not steady. There were notable fluctuations in the amount of energy used, and in the yearly rate of growth in energy consumption.

Between 1973 and 1979, total industrial end-use energy demand grew by 30 per cent, or by nearly 4.5 per cent per year. During this period, the Petrosar petrochemical plant at Sarnia, began production. This industrial complex is an extremely large user of energy, and was planned, built, and came into operation before the rapid escalation of Canadian energy prices in the 1979 to 1981 period. When operating at design capacity, the plant would use about 20 petajoules in direct energy uses — the equivalent of more than three million barrels of oil a year. Oil-based feedstock requirements for Petrosar could amount to a further 120 petajoules a year.

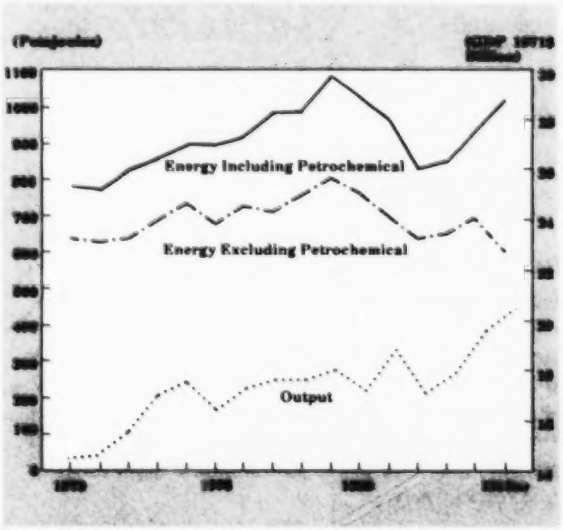
The start-up of this plant led to a huge increase in petrochemical and other non-energy uses. Nearly half of Ontario's growth in industrial end-use energy consumption in the late-1970s was due to the increase in petrochemical and non-energy uses that coincided with the start-up of Petrosar's operations.

After 1979, industrial energy use in Ontario began to decline. The total end-use energy consumption in 1985 is estimated to have been 3.4 per cent lower than in 1979. Several factors combined to produce this downward trend: a severe recession in 1981-1982, rapid increases in energy prices, and a concerted effort by most industrial companies to become more efficient in their energy use.

Economic Output — The Driving Force for Energy

Over the last 15 years, Ontario's industrial energy use has expanded and contracted with industrial output. By the end of 1985, Ontario's industrial output was 41 per cent higher in real terms than in 1970. However, output and energy use did not expand smoothly, since there were some periods of strong growth, as well as more than one serious recession.

INDUSTRIAL ENERGY AND OUTPUT



Source: Statistics Canada, Conference Board of Canada

The relationship between industrial output and energy consumption is direct. As manufacturers, resource companies and farmers respond to increased demand for their goods, they require more inputs in the production process, and energy is one of the basic building blocks in all industrial products.

But energy is more important in some industries than others. Energy-intensive industries, such as pulp and paper, non-metallic minerals, industrial chemicals and primary metals, account for a large proportion of Ontario's total industrial output, employment and exports. Over the 1971-85 period, the proportion of manufacturing output produced by this group of industries did not change significantly. This was primarily due to a balance between increases and declines among several heavy users of energy. For example, primary metals and non-metallic minerals output declined, while chemicals production expanded in relation to total manufacturing. At the same time, significant progress was achieved by nearly all industries in reducing the amount of energy required to produce a unit of output.

Table 1: Ontario's Energy Intensive Industries

(percentage of total manufacturing)

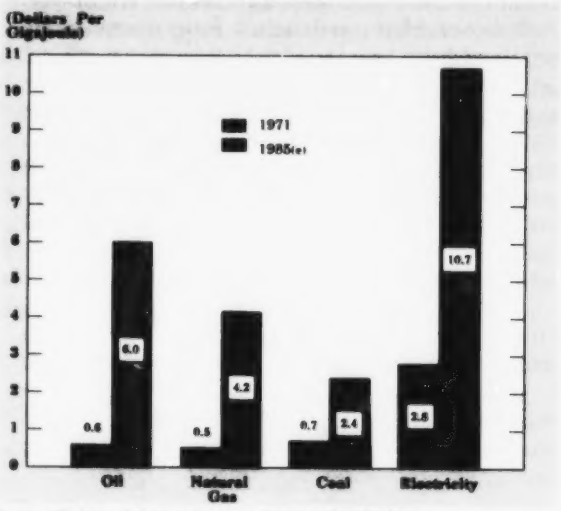
Industry	Output 1971	Output 1985 (est.)	Employment 1971	Employment 1985 (est.)
Pulp and Paper	2.8	2.4	2.7	2.7
Primary Metals (iron and steel, nickel, copper)	9.0	7.0	9.0	8.1
Chemicals (industrial chemicals, fertilizers, paints)	6.3	9.1	5.1	6.5
Non-Metallic Minerals (lime, cement, abrasives)	2.9	2.0	3.3	2.9
Total - above industries	21.0	20.5	20.1	20.2

Industrial Energy Efficiency

Rising prices for all forms of energy were a major catalyst for Ontario industries to improve their energy efficiency. Between 1971 and 1985, the energy prices for industrial customers in Ontario increased dramatically. For example, industrial users of fuel oil paid 10 times more per litre in 1985 than in 1971. Purchasers of electricity and natural gas paid four and eight times as much respectively.

The cost structure of Ontario's industrial output was significantly affected by these huge price increases. For Ontario's manufacturing sector as a whole, the electricity and fuel portion of total operating costs almost doubled between 1971 and 1985. The impact on the cost structures of energy-intensive industries, such as cement, pulp and paper, chemicals and iron and steel, was pronounced.

INDUSTRIAL FUEL PRICES



Source: Ministry of Energy, based on Statistics Canada data

Table 2: Energy Costs as a Share of Total Costs

(per cent of total costs)

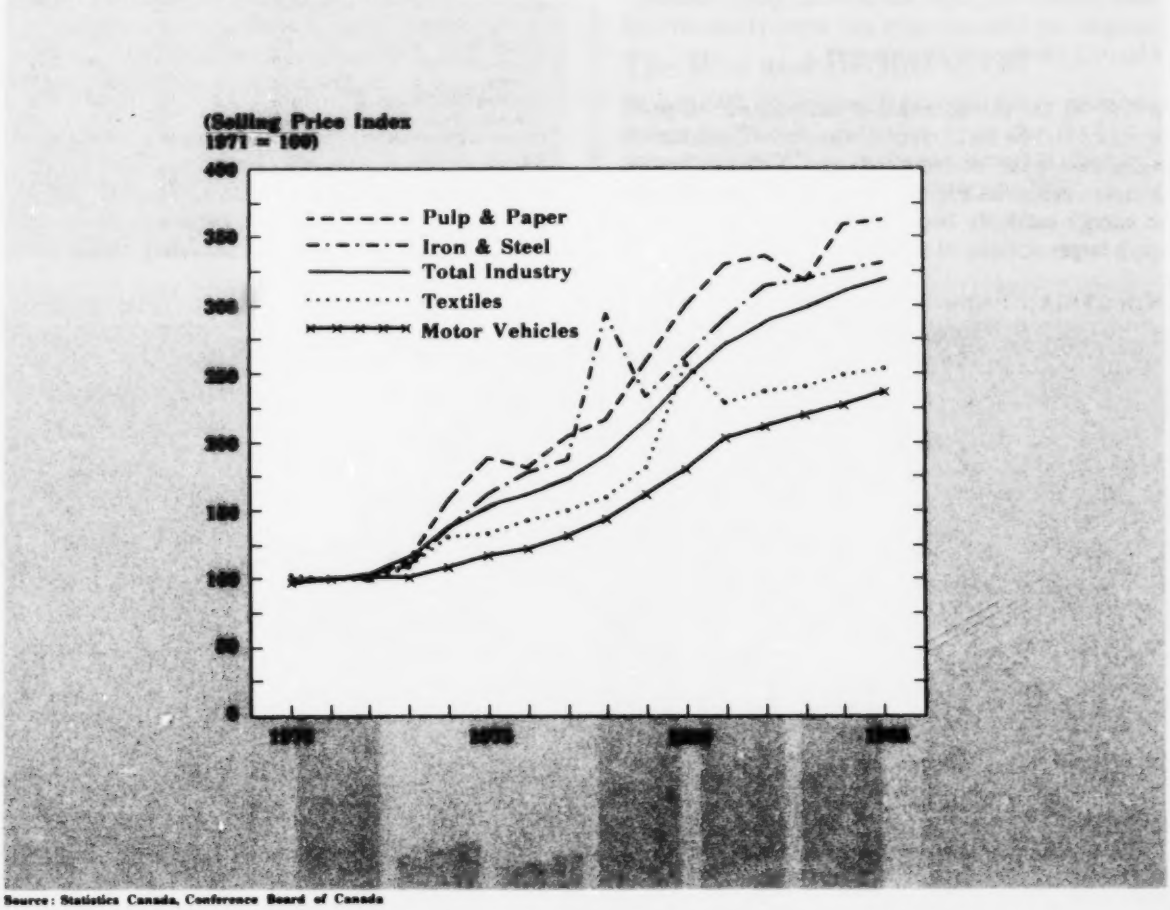
Energy Intensive Industries	1971	1985 (est.)
Lime	53	60
Cement	24	36
Industrial Chemicals	19	49
Pulp and Paper	18	26
Abrasives	20	25
Smelting and Refining	23	23
Iron and Steel[1]	7	17
Less Energy Intensive Industries		
Agriculture	5	10
Aluminum Fabricating	4	10
Plywood and Veneers	5	9
Animal Foods	6	6
Dairy Products	6	7
Agriculture Implements	3	5
Rubber Products	3	5
Mixed Fertilizers	3	4
Motor Vehicle Parts	2	3
Paper Converters	2	4
Textiles	3	4
Furniture and Fixtures	2	3
Cleaning Compounds	2	3
Electrical Equipment	1	2
All Manufacturing	4	7

[1]Does not include coking coal

The huge energy cost increases Ontario industries experienced in the 1971-85 period could have seriously damaged the market competitiveness of much of the province's industrial base. During this period, the selling prices of energy-intensive products increased more rapidly than the prices of other, less energy-intensive products. However, at the same time that energy prices and costs were escalating rapidly, the Canada/U.S. dollar exchange rate was deteriorating. This reduction in the exchange rate made Canadian goods relatively cheaper in the U.S. — largely offsetting energy cost increases, and preserving the market share of many of Ontario's export-oriented industries.

For the industrial sector as a whole, energy intensity (the amount of total end-use energy consumed per real dollar of output) declined by only 6 per cent over the entire 1971-85 period. Excluding petrochemicals and non-energy uses, energy intensity declined by about one-third over the same period. However, the most significant progress in reducing Ontario's energy intensity has occurred since 1979. By 1985, the province's total end-use energy intensity was about 17 per cent less than its high point in 1979. Excluding petrochemicals and non-energy uses, Ontario's industrial energy intensity was 34 per cent lower in 1985 than in 1979.

INDUSTRY SELLING PRICE INDEX



Source: Statistics Canada, Conference Board of Canada

There are several reasons why Ontario's industries continued to be so energy-intensive until the late 1970s. One was the strong growth in petrochemical energy use. Another factor was the relatively slow rate of energy price increases after the initial 1973-74 price shock. Canadian oil prices did not rise as quickly as international oil prices in the early 1970s. By the late 1970s, the general level of prices was increasing more rapidly than fuel prices — thus making energy relatively less expensive than other inputs. As a result, most Canadian and Ontario industries had not invested as heavily as their foreign counterparts in energy-saving technology and equipment.

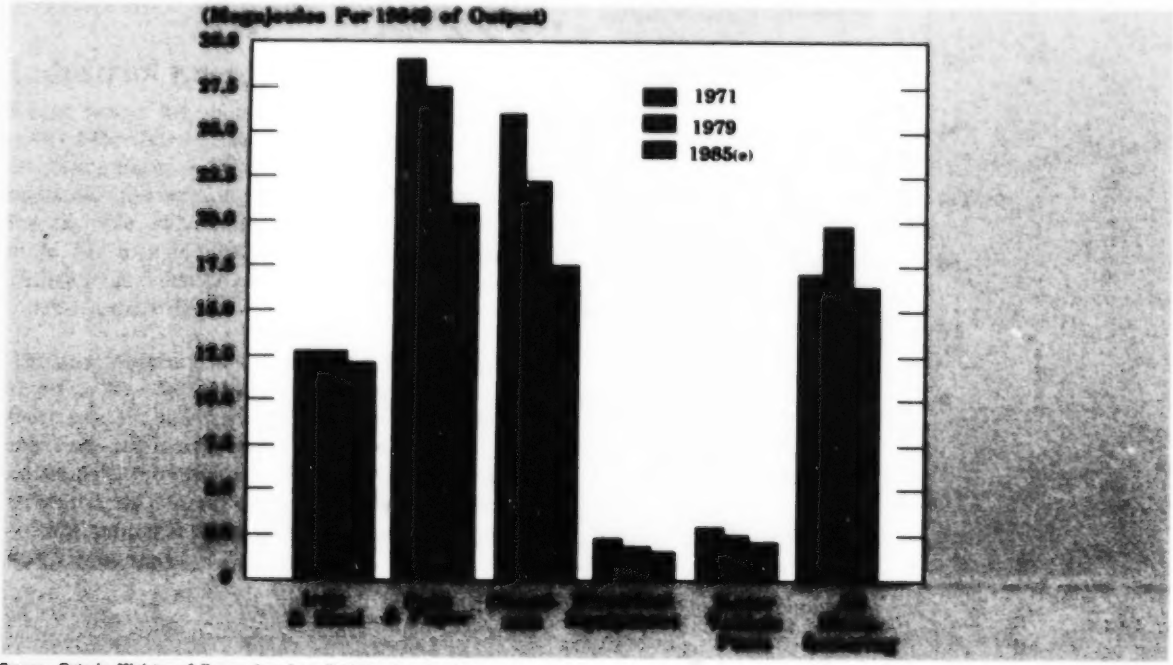
Some industries, primarily the largest energy users, became interested in energy conservation in the early 1970s and took steps to reduce their energy intensity. Examples are Ontario's pulp and paper producers and industrial chemical manufacturers.

In 1979-80, the second round of international oil price increases and the more rapid movement of Canadian oil prices toward the international price, jolted the rest of Ontario's industries into action. Reducing expenditures on energy suddenly became a major priority with a much larger number of industries.

Table 3: Energy Intensity in Manufacturing

Lime	74.9	80.3	80.8	+8.1	+10.7
Cement	73.9	74.5	99.8	+0.8	+35.0
Industrial Chemicals	28.1	22.3	17.5	-44.6	-21.5
Pulp and Paper	28.1	27.5	20.9	-5.8	-24.0
Abrasives	15.8	15.3	14.5	-2.9	-5.4
Smelting and Refining	53.0	52.3	28.2	-1.2	-46.9
Iron and Steel	12.7	12.9	12.1	+1.8	-6.2
Low Energy Intensive Industries					
Agriculture	6.3	6.7	5.4	+6.3	-19.4
Aluminum Fabricating	4.7	4.4	6.0	-6.4	+37.9
Plywood and Veneers	8.5	7.3	5.8	-14.1	-20.5
Animal Feeds	3.1	2.3	2.2	-25.8	-4.3
Dairy Products	2.9	2.3	2.3	-20.7	0.0
Agricultural Implements	4.0	2.7	4.5	-32.5	+67.9
Rubber Products	4.8	4.5	3.8	-6.3	-15.8
Mixed Fertilizers	1.1	0.8	0.8	-23.8	0.0
Motor Vehicle Parts	3.0	2.5	2.2	-16.7	-12.0
Paper Converters	2.8	2.5	1.7	-3.6	-32.0
Textiles	4.9	5.4	3.7	+10.2	-31.5
Furniture and Fixtures	1.8	1.7	1.6	-5.6	-5.9
Cleaning Compounds	4.3	2.8	2.2	-34.9	-21.4
Electrical Equipment	2.4	1.9	1.6	-20.8	-15.8
All Manufacturing	5.8	5.1	3.9	-12.1	-23.5

INDUSTRIAL ENERGY INTENSITIES



Source: Ontario Ministry of Energy, based on Statistics Canada data

For example, between 1971 and 1979, Ontario's textile industry increased its energy used per dollar of output by about 10 per cent. But since 1979, this ratio has declined by more than 30 per cent.

A similar pattern is evident in the cement and iron and steel industries. However, a few manufacturing industries exhibited a growth in energy intensity after 1979. This can be attributed to the effects of the recession of 1981-82 that caused many industries to operate at less than their most efficient production capacity. Nevertheless, manufacturing in total showed impressive gains in reducing energy intensity in the 1971-85 period.

Many factors contributed to the reduction. Many companies made plant managers and other employees more aware of the importance of reducing energy consumption and costs. As well, a considerable amount of aging, inefficient equipment has been replaced, as energy costs increased with rising prices in general.

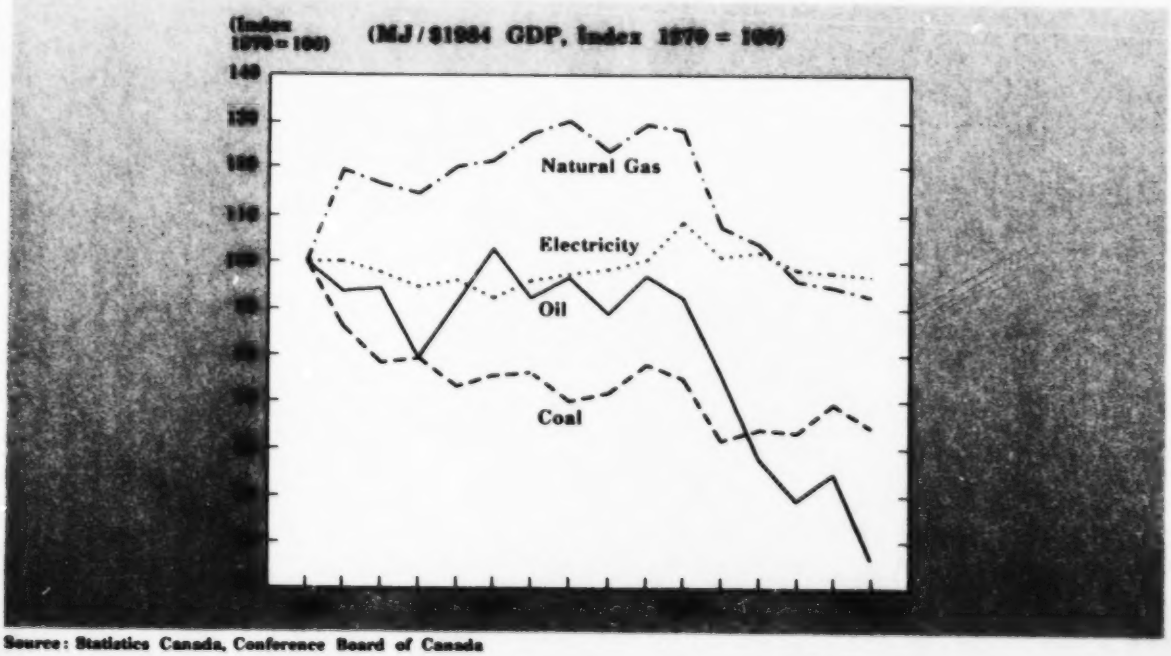
Research to develop new production processes and methods that save energy also became a priority. For example, some cement companies switched from the wet production process to a dry process, saving one-third over their previous energy costs. Automobile manufacturers installed electrostatic paint-bonding systems, to replace convection heat drying. As well, basic oxygen furnaces have largely replaced open-hearth furnaces for steel-making. And continuous casting is replacing batch-processing — eliminating the energy-wasting practice of melting the same batch of steel more than once.

Many industries have now installed dual-fuel capabilities, such as boilers than can switch between natural gas and fuel oil at short notice. This reduces the chance of a production interruption due to energy supply problems, and also allows the firms to take advantage of lower-cost fuels when they are available. Plants with dual-fuel capability could account for as much as 40 per cent of Ontario's total industrial energy use, so the impact of this cost-saving technique is potentially huge.

The Rise and Decline of Oil

Back in 1970, oil supplied 27 per cent of the total end-use energy for Ontario's industries. Even after the first oil price shock in 1973, oil expanded its market share to 32 per cent of industrial end-use energy by 1980.

INDUSTRIAL FUEL INTENSITIES



Source: Statistics Canada, Conference Board of Canada

The second round of international oil price hikes in 1979-80, however, resulted in a faster pass-through of price increases to consumers, and in a sharp decline in the amount of oil used by industry. By 1985, the market share held by oil for all industrial uses is estimated to have declined by 3 percentage points from the 1980 level, and the volume used was down by 10 per cent. And, if petrochemical and non-energy uses for oil are excluded from the total, the progress in reducing oil consumption is much more dramatic. On this basis, oil supplied 17 per cent of total energy in 1980, and dropped by one-half to around 9 per cent in 1985.

The decline in Ontario's oil consumption after 1980 is also evident on the basis of energy consumption per unit of industrial gross domestic product. Natural gas and coal also exhibited sharp declines over the same period, with coal consumption recovering somewhat after 1981.

Electricity intensity is notable for its relative stability. This is due to some peculiar characteristics of electricity use. There is no convenient substitute for electricity in lighting and motor applications, for example. As well, some offsetting developments, such as new, electricity-intensive industrial processes, have been added to the economy — processes that are both energy-efficient and produce high-value output.

Natural gas contributed to the decline in oil use by substituting for oil in many areas of the economy. For example, 30 per cent of the energy used to dry grain in Ontario was supplied by oil in 1976. By 1985, oil was used in less than 5 per cent of grain-drying operations, while natural gas and propane had increased to almost 95 per cent.

Nevertheless, the overall industrial market in Ontario has not been a particularly strong one for natural gas. In fact, our industry used about the same volume of natural gas in 1985 as it did in 1973. Relatively high prices, compared to competitive energy sources such as electricity, wood waste and coal, are the major reason why natural gas has lost its industrial market share since 1973.

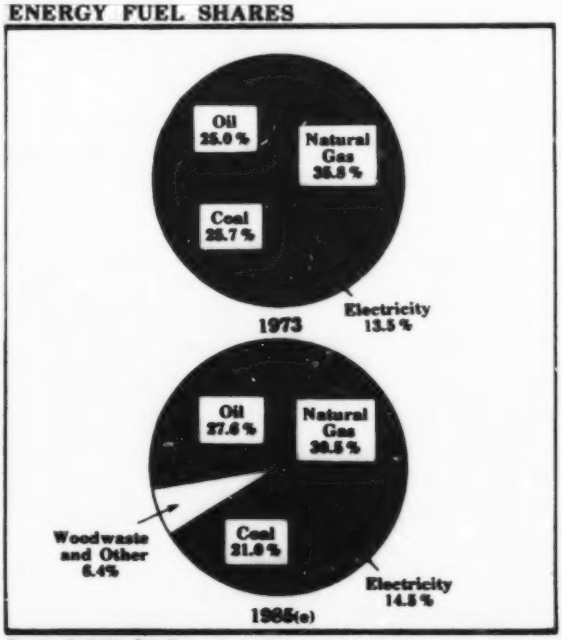
Electricity is the only major fuel that has increased its market share in Ontario since 1973. New electricity-intensive technologies, and applications such as automation, process control systems, electronics, paint-drying and computer-aided design and manufacturing, have emerged or expanded in the last decade. These new uses and competitive electricity prices contributed most significantly to the more extensive use of electricity.

In 1985, coal use (excluding coal for electricity production) was virtually the same as in 1973. Up to 1982, however, coal use had declined by nearly 20 per cent, due to the slump in steel output and a preference for cleaner, more easily-used fuels, such as natural gas. But since 1982, coal consumption has increased, with the recovery in steel production and a shift away from more expensive oil and gas by some industrial concerns.

Coal is a difficult industrial fuel to use for several reasons. It requires special handling and processing facilities that are expensive to build and difficult to maintain. In addition, burning coal can cause or worsen environmental problems, such as acid rain. Nevertheless, some large energy consumers, notably pulp and paper producers and the cement industry, find that coal is a viable alternative to oil and gas. As a result, during the 1980-85 period, a number of industrial concerns switched partially or entirely to coal for their energy needs.

The two other fuels most commonly used by industry are wood waste and spent pulping liquor. These fuels are used by pulp and paper manufacturers and have supplied about half of their energy needs in recent years. As a percentage of total industrial energy, wood waste and spent pulping liquor increased from just over 4 per cent in 1980 to more than 6 per cent in 1985.

ENERGY FUEL SHARES



Source: Statistics Canada

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